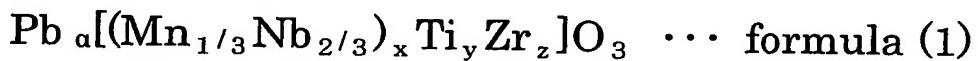


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## FIG. 1



In formula (1),

$$0.95 \leq \alpha \leq 1.02,$$

$$0.02 \leq x \leq 0.15,$$

$$0.48 \leq y \leq 0.62,$$

$$0.30 \leq z \leq 0.50; \text{ and}$$

$\alpha$ ,  $x$ ,  $y$  and  $z$  are respectively given in molar ratio.

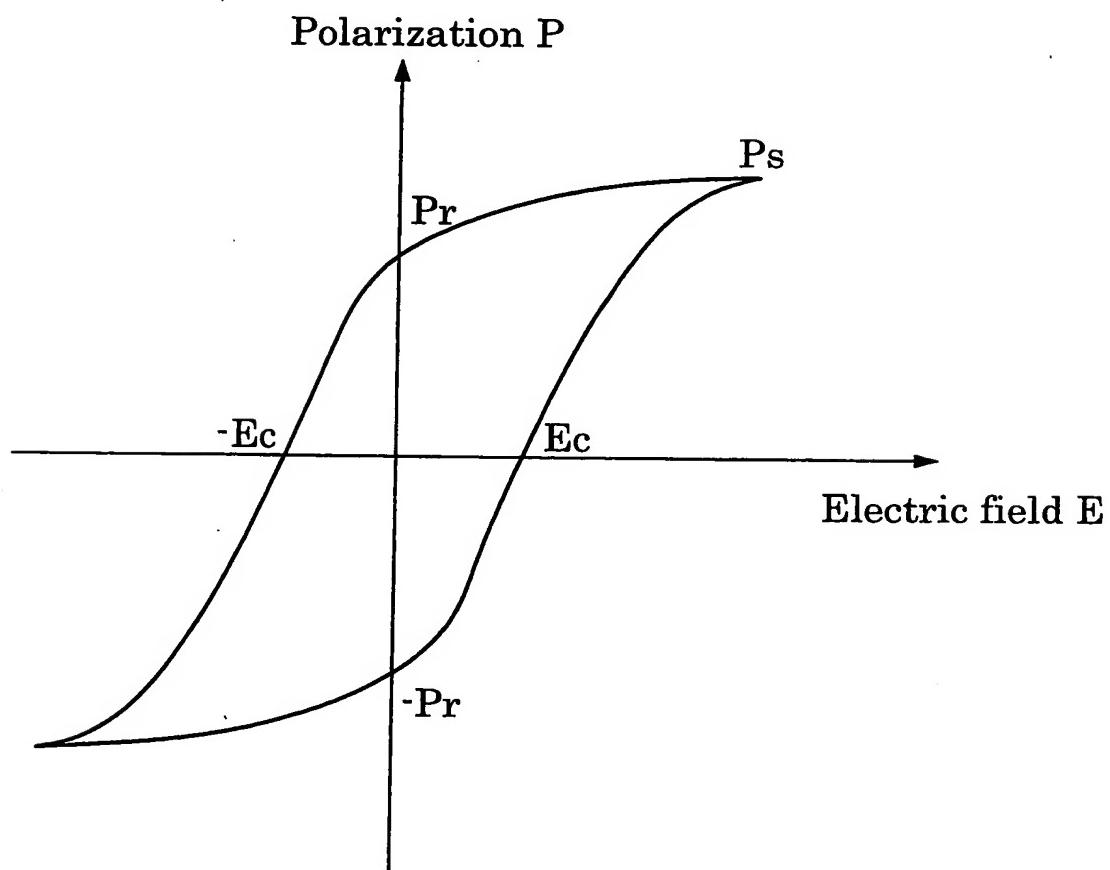
$$k_{15} = \sqrt{\frac{\pi}{2} \cdot \frac{Fr}{Fa} \cot\left(\frac{\pi}{2} \cdot \frac{Fr}{Fa}\right)} \quad \cdots \text{ formula (2)}$$

In formula (2),  $Fr$  represents a resonant frequency and  $Fa$  represents an anti-resonant frequency.

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FIG. 2

Hysteresis loop for polarization P and electric field E



Pr: Remanent polarization  
Ps: Saturation polarization  
Ec: Coercive electric field

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FIG. 3A

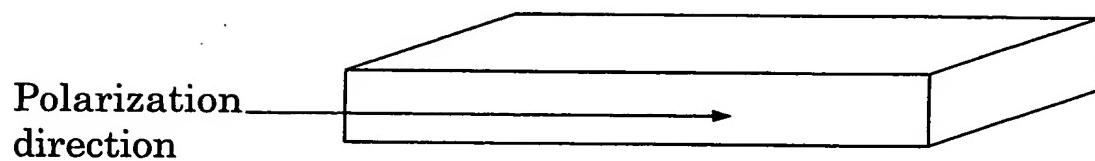
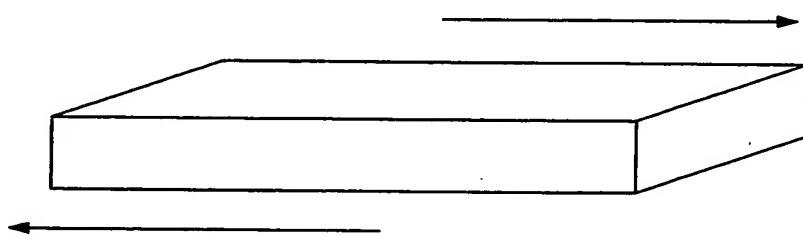


FIG. 3B



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## FIG. 4

$$F_0 = Fr \sqrt{1 + \frac{C_1}{C_0 + C_L}} \quad \dots \text{formula (3)}$$

In formula (3),  $F_0$  represents an oscillation frequency,  $Fr$  represents a resonant frequency,  $C_1$  represents a motional capacitance and  $C_0$  represents a shunt capacitance; and  $C_L$  is defined by formula (6).

$$C_1 = \frac{Fa^2 - Fr^2}{Fa^2} Cd \quad \dots \text{formula (4)}$$

In formula (4),  $C_1$  represents a motional capacitance,  $Fa$  represents an anti-resonant frequency,  $Fr$  represents a resonant frequency, and  $Cd$  represents a free capacitance.

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## FIG. 5

$$C_0 = Cd - C_1 \quad \cdots \text{formula (5)}$$

In formula (5),  $C_0$  represents a shunt capacitance,  $Cd$  represents a free capacitance, and  $C_1$  represents a motional capacitance.

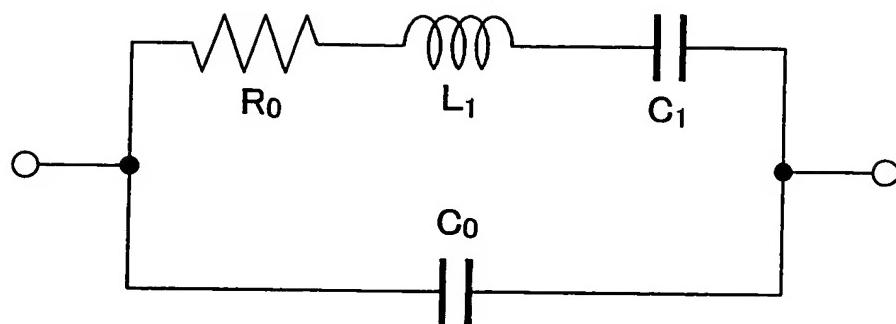
$$C_L = \frac{C_{L1} \cdot C_{L2}}{C_{L1} + C_{L2}} \quad \cdots \text{formula (6)}$$

$$\Rightarrow \frac{C_{L1}}{2} \quad (C_{L1} = C_{L2})$$

In formula (6),  $C_{L1}$  represents a load capacitance and  $C_{L2}$  represents another load capacitance.

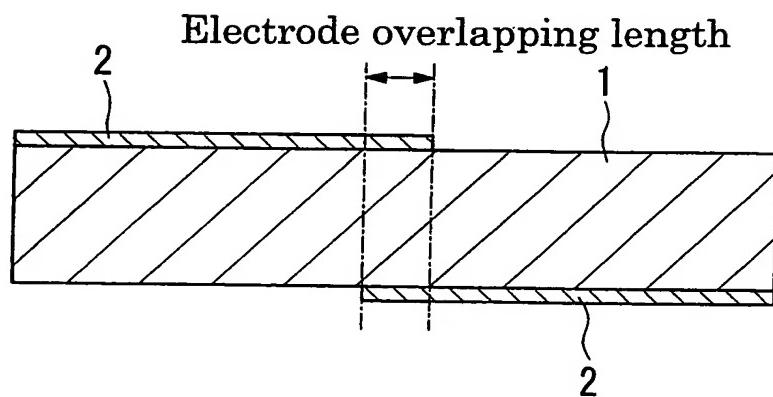
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FIG. 6



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FIG. 7



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FIG. 8

Sample No.	Additive(s)	Load (wt%)	$\Delta k_{15}$ (%)	$Q_{max}$	Polarization conditions		
					Tempe- rature (°C)	Time (min)	Electric field (kV/mm)
* 1	$\text{Cr}_2\text{O}_3$	—	-4.4	120	150	1	3
2		0.05	-1.9	97			
3		0.10	-1.2	130			
4		0.20	-2.0	129			
* 5		0.30	-3.7	108			
* 6		0.50	-4.8	81			
* 7		0.05	-4.5	81			
* 8	$\text{MnCO}_3$	0.20	-4.5	129			
* 9		0.30	-4.7	120			
* 10		0.50	-4.2	85			
11	$\text{Cr}_2\text{O}_3$ $\text{MnCO}_3$	0.05 0.05	-2.1	118			

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## FIG. 9

Sample No.	Additive(s)	Load (wt%)	$\Delta k_{15}$ (%)	$\Delta F_0$ (%)	$\Delta F_r$ (%)
12	$\text{Cr}_2\text{O}_3$	0.05	-0.58	-0.02	0.03
13		0.10	-0.49	-0.03	0.04
14		0.20	-0.60	-0.03	0.01

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## FIG. 10

Sample No.	$Pb_{\alpha}[(Mn_{1/3}Nb_{2/3})_xTi_yZr_z]O_3$				$Cr_2O_3$ [wt%]	$\Delta k_{15}$ (%)	$Q_{max}$
	$\alpha$	x	y	z			
15	0.98	0.05	0.55	0.40	0.05	-1.9	92
16		0.13	0.49	0.38		-2.9	177
17		0.09	0.60	0.31		-1.8	98
18		0.03	0.48	0.49		-2.8	110
19	0.995	0.05	0.55	0.40	0.10	-1.9	85
20		0.03	0.48	0.49		-1.1	76